Australian Curriculum LINKED LESSONS

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In providing a continued focus on tasks and activities that help to illustrate key ideas embedded in the new Australian Curriculum, the focus in this issue is on Measurement in the Measurement and Geometry strand.

	Number & Algebra	Measurement & Geometry	Statistics & Probability
Understanding		■	
Fluency			
Reasoning		■	
Problem Solving		■	

The following small unit of work on measurement has activities that can be modified to meet the requirements of particular year level descriptors in the following aspects of the Measurement and Geometry strand. There is also a direct link to the Number and Algebra strand through the necessity to quantify.

Measurement and Geometry: Using units of measurement

FOUNDATION YEAR

Use direct and indirect comparisons to decide which is longer, heavier or holds more, and explain reasoning in everyday language

ACMMG006

YEAR 1

Measure and compare the lengths and capacities of pairs of objects using uniform informal units

ACMMG019

YEAR 2

Compare and order several shapes and objects based on length, area, volume and capacity using appropriate uniform informal units

ACMMG037

YEAR 3

Measure, order and compare objects using familiar metric units of length, mass and capacity

ACMMG061

YEAR 4

Use scaled instruments to measure and compare lengths, masses, capacities and temperatures

ACMMG084

YEAR 5

Choose appropriate units of measurement for length, area, volume, capacity and mass

ACMMG108

YEAR 6

Connect decimal representations to the metric system

ACMMG135

Convert between common metric units of length, mass and capacity

ACMMG136

Solve problems involving the comparison of lengths and areas using appropriate units

ACMMG137

NOTE:
For full Content Descriptions please visit the Australian Curriculum web site:
www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACMMGXXX
Replace XXX with the course code numbers marked in red.

The necessity to quantify in measurement sometimes means that measurement lessons are really number lessons given in a measurement context. For example, a question such as "I have two pencils that are 5 cm long; what is their total length?" is not really a measurement lesson, it is a lesson about calculating. As a rough guide, if a lesson does not require estimation and then an 'act' of measurement through some sort of physical manipulation, it needs serious consideration as to whether it is a measurement lesson. Therefore, "Estimate which of these two pencils is longer and how long both pencils are. How long is each of the pencils? How much longer, if at all, is the longer pencil than the shorter pencil?" are statements and questions which takes this lesson into the Measurement strand.

There are six attributes of measurement which are (in no particular order):

- length
- area
- volume
- capacity
- time
- mass.

Although usually related to the Number strand, some writers include the attribute of money, one reason being that money is seen as a measure of value. Other writers talk of Angle as being an attribute of measurement, whilst others prefer to address the idea of angles in geometry.

Research tells us there is a learning sequence which needs to be considered in the teaching of measurement. This sequence is:

- identify the attribute to be measured;
- compare and order;
- use non-standard units;
- use standard units; and
- apply measurement.

For this unit of work called 'Measure Me!' we will be working with the attribute of Length and following the learning sequence, albeit with the overlaps, in stages which occur in this non-linear continuum. It is a unit of work which starts off at a level at which almost all students can engage and works up to some fairly rigorous work with ratio, one of the more difficult mathematical ideas for students to understand.

In the initial part of the unit, it is important to get the students to reflect on some of the different ways we can measure the human body and the units we use to make these measurements. In doing this, it is not unusual for students to talk about the attributes of height and weight and quite often will talk about 'width' or 'around' as they probably have had a tape measure used to measure their waist. They will often talk about centimetres, metres and kilograms and when asked about the instruments we can use, they will articulate the use of bathroom scales, tape measures and door frames!

We then move into discussing how we can measure body parts. Most students realise that finding the weight of an individual body part (for example an arm) is very difficult, even though some will lay an arm on a scale and tell you that doing so is a legitimate manner of measuring. It is usually quite easy to steer the conversation to the aim of this activity as being to find the length around, and along, body parts.

Although the use of standard units is not required at this point, I like to start developing the students' understanding of the size of one metre. Over a few spaced periods, I get the students to start to hone their estimation skills about a metre. For example, they are required to cut a streamer one metre long, place two objects one metre apart on the floor, hold their hand one metre above the ground, etc. For the more adventurous of the students (and I challenge you to do this for yourself), get them to draw a spiral on a piece of A4 paper that is a metre long. Then there is the obvious and quite illustrative problem to pose of, how do you then test your estimation for accuracy!

In order that students can test their estimations (other than the spiral) I have a number of dowelling rods which have been cut to a length of one metre but contain no marks or divisions, as I want the students initially to get a feel for a metre as the unit. It is important to revisit these estimations a few times to give the students a chance to sharpen this skill, doing this once is not very educative, but it is very rewarding to see how after a few times the students become quite proficient at estimating this length.

One of the least expensive and most effective items in my classroom is the roll of paper tape. It has a multitude of uses and is invaluable for measuring length. A word of warning here, do not use crepe-paper streamers as crepe-paper streamers plus sweaty foreheads (or other body parts) can equal coloured dye on children and their clothes!

Measure me!

Use tape and cut the lengths to show:

1. How tall you are.
2. How long your leg is.
3. How long your arm is.
4. Your arm span (that's both arms, finger tips to finger tips).
5. How long your hand is.
6. How wide your hand is.
7. How big around your head is.
8. How long your foot is.

Don't forget to label the different pieces.

Make sure each student labels the pieces of tape with their name and the body part they used it to measure. I find that a labelled snap-lock bag for each student's pieces of tape is a good way of storing the pieces. If the bags are collected at the conclusion of the lesson, there is a good chance that all the pieces will be there the next time you want to use them.

From this point we can extend the activity into comparing and ordering specific body parts from the students in the class using the paper strips. We can then determine through the use of considered non-standard units how big each strip is. The use of non-standard units keeps the focus at this stage on some important principles of measurement; no gaps or overlaps of the units and the use of one regular unit. At this point I like to get the students to try to measure their strips of paper for each of their body parts against the metre dowelling to encourage them to reason and understand that the choice of both the tool and the unit of measurement are important. Once we have come to the conclusion that the metre stick is not accurate to answer the question of how long the strips are, or what is the difference between two strips, it allows us to investigate smaller units.

Measure me!

1. How tall is the tallest person in your group?
2. How tall is the shortest person in your group?
3. How long is the longest body part?
4. How long is the shortest body part?
5. How long is your leg?
6. How long is the longest leg in your group?
7. How long is the longest arm in your group?
8. How long is the shortest leg in your group?
9. How long is the shortest arm in your group?
10. How much taller is the tallest person in your group than you?
11. How much shorter is the shortest person in your group than you?
12. How much taller is the tallest person in your group than the shortest person?
13. How much longer is the longest leg in your group than the shortest leg?
14. How much longer is the longest arm in your group than the shortest arm?

The use of non-standard units does, however, soon raise the issue of the need for standard units and why they are useful. Students' innate desire for fairness soon raises the matter that even though my arm may be six of my hand-spans long, it may in fact be shorter than my friend's arm which is five of their hand-spans long. When this issue is raised, the discussion can be relatively easily guided to the fact that standard units are useful when measurements are recorded for later use, or transported, or communicated, or used for calculation. It should be noted that all of the work previously completed using non-standard units can be used with standard units as the principles are the same. I also find this is a really good time to see how well students can use and read a dress-maker's tape. Explore whether the students measure and read from the zero and understand that the small graduations can be used to make the measurement more accurate.

There are many fantastic pieces of literature that can be used to contextualise the learning of measurement and one such book is *Norman Enormous* by the Australian author Dave Hackett. The eponymous Norman Enormous seems to have a glandular

problem, and perhaps not surprisingly, is enormous. He has a new acquaintance called Norman Not-so-enormous and this is quite a lovely book, which works on a number of levels, about the unlikely friendship they develop. Using this as the background, it is possible to take the unit of work in the direction of proportional reasoning by using the clues given in the story, the associated pictures, some estimation, and some research about the relationship of the ratio of the length of body parts. The Internet is always a useful place for finding information about these ratios and one document I found helpful was from the New Zealand Census at School website: www.censusatschool.org.nz/2005/documents/body-ratio-teacher-notes.en.pdf. Using the information provided here, the students can then explore if their bodies match the expected ratios.

Measure me!

I found the table below on the Internet. Amongst other things, it's telling me that a person's height is equal to one quarter of the length of their femur or eight and a half hand-spans.
Use your own measurements to make a comparison. Do you agree with the chart?

Table of common body part ratios

Body part	Stated ratio	My ratio
Femur	1 : 4	
Ulna	1 : 7 — same as foot length	
Tibia	1 : 5	
Cranium	1 : 3	
Hand span	1 : 8.5	
Arm span	1 : 1	

We would like to encourage any teachers trying these ideas with their classes to send in a short paragraph explaining what happened. Samples of children's work illustrating how they tackled these tasks would be appreciated.

References

Australian Curriculum and Reporting Authority [ACARA]. (2013). *The Australian Curriculum: Mathematics F–10*. Canberra: ACARA.

Hackett, D. (2009). *Norman Enormous*. Melbourne: Puffin Books.